14 *Central Valley and Bay-Delta Region*


Tim Palmer

The Central Valley and Bay-Delta Region comprises most of the low-lying lands of Central California. Much of the region is part of a vast hydrological system that drains 40 percent of the state's water. This water, falling as either rain or snow over much of the northern and central parts of the state, drains along the Sacramento and San Joaquin rivers into the Delta. In the Delta, freshwater from these rivers mixes with saltwater from San Francisco Bay, creating a rich and diverse aquatic ecosystem. Encompassing 1,600 square miles of waterways, the San Francisco Bay and Delta together form the West Coast's largest estuary and the second-largest estuary in the nation.

The region has four distinct subregions: the San Francisco Bay Area, the Delta, the Sacramento Valley, and the San Joaquin Valley. Each has unique combinations of climate, topography, ecology, and land-use patterns.

The San Francisco Bay Area subregion, the most densely populated area of the state outside of the Southern California metropolitan region, consists of the low-lying baylands, aquatic environments, and watersheds that drain into San Francisco Bay. It is bounded on the east by the Delta subregion, on the north by the North Coast Region, on the south by the Central Coast Region, and on the west by the Pacific Ocean. Low coastal mountains surround San Francisco Bay, with several peaks rising above 3,000 feet. The region receives 90 percent of its surface water from the major Central Valley rivers via the Delta. Other major rivers draining into the Bay include the Napa and Petaluma rivers and Sonoma, Petaluma, and Coyote creeks. The Bay Area has relatively cool, often foggy summers and cool winters, strongly influenced by marine air masses. Rain falls almost exclusively during the winter season (October to April) and averages 15–25 inches annually, with occasional snowfall at higher elevations. Rainwater runs off rapidly, and most of the smaller streams are dry by the end of the summer.

The topography allows for a variety of different habitats. The Bay itself has both deep and shallow estuarine (mixed freshwater and saltwater) environments. In addition to estuarine species, the Bay also supports many marine species, including invertebrates, sharks, and even, on occasion, whales. Along the shoreline are coastal salt marsh, coastal scrub, tidal mud-flats, and salt ponds. Freshwater creeks and marshes, especially those that still have patches of riparian vegetation, are home to aquatic invertebrates and freshwater fish. Upland areas support a mixture of grasslands, chamise chaparral, and live oak and blue oak woodlands. Small stands of redwood, Douglas fir, and tanoak grow in moister areas.

The Great Central Valley of California contains the other three subregions: the Sacramento Valley, the San Joaquin Valley, and the Sacramento–San Joaquin Delta. Together, they form a vast, flat valley, approximately 450 miles long and averaging 50 miles wide, with elevations almost entirely below 300 feet. The Sutter Buttes, a circular set of 2,000-foot-high hills that rises from the middle of the valley floor (promoted locally as the "Smallest Mountain Range in the World"), is the only topographic feature that exceeds that height. The Central Valley is surrounded by the Sierra Nevada on the east, the coastal ranges on the west, the Tehachapi Mountains on the south, and the Klamath and Cascade mountains on the north. Less influenced by marine air than San Francisco Bay, the valley's climate has hot, dry summers and foggy, rainy winters. Annual rainfall averages from 5 inches to 25 inches, with the least rainfall occurring in the southern portions and along the west side (in the rainshadow of the coastal mountains).

Agriculture dominates land uses in the Central Valley, with very few remnants of natural land remaining. The major natural upland habitats are annual grassland, valley oaks on floodplains, and vernal pools on raised terraces. The more arid lands of the southern San Joaquin Valley also contain alkali sink and saltbush shrublands. Slow-moving rivers along the valley floor provide habitat for fish and invertebrates and help maintain adjacent riparian, wetland, and floodplain habitats.

Hydrology is the main difference between the three Central Valley subregions. The Delta is a low-lying area that contains the tidally influenced portions of the Sacramento, San Joaquin, Mokelumne, and Cosumnes rivers. The Delta was once a huge marsh formed by the confluence of the Sacramento and San Joaquin rivers. Once described as a "terraqueous labyrinth of such intricacy that unskillful navigators have been lost for days in it" (Bryant 1848), it has been extensively drained and diked for flood protection and agriculture. Exposure of the rich, organic soils behind these levees has increased oxidation rates to such an extent that the land is breaking down and much of the surface has now subsided below sea level. Due to its natural patterns of flooding, the Delta is relatively less populated than the other subregions.

The second subregion, the Sacramento Valley, contains the Sacramento River, the largest river in the state. This river historically overflowed into several low-lying areas, particularly in its lower reaches. The lower 180 miles of the river, below Chico Landing, are now constrained by levees, and excess floodwaters are diverted into large bypasses to reduce risks to human populations.

The third subregion of the Central Valley, the San Joaquin Valley, has two distinct, or separate, drainages. In the northern portion, the San Joaquin River flows north toward the Delta. It captures water via several major rivers that drain the central Sierra Nevada. The southern portion of the valley is isolated from the ocean and drains into the closed Tulare Basin, which includes the beds of the former Tulare, Buena Vista, and Kern lakes. These lakes and vast wetlands historically were fed by the rivers that drain the southern Sierra Nevada (the Kings, Kaweah, Tule, and Kern). These lakes are now dry most of the time because water has been diverted to upland agriculture. Runoff during the wettest years will occasionally flood out of river channels and temporarily refill some of these lakebeds. The California Aqueduct extends along the entire western edge of the valley, delivering water from the Delta to farmers in the Tulare basin and over the Tehachapi Mountains to Southern California.

The wildlife of this region is beset by a wide variety of stressors, described below. The major problem has been the loss, degradation, and fragmentation of habitats, both terrestrial and aquatic, due to the development of agriculture and urban areas. Many of the streams have been dammed, blocking fish migration, or have been so severely degraded that they are no longer usable by salmon. Flood control structures, such as dikes, levees, and hardened embankments (**riprap**), have altered floodplain habitats like riparian forests and wetlands throughout the region. This loss of habitat has led to the extirpation of several species, including elk and pronghorn from the Central Valley and yellow rail and grizzly bear from

California (TNC 1987). Many other species that persist on the remaining habitat fragments are at risk of local or rangewide extinction. Ninety-five percent of the historic Central Valley salmon habitat has been lost (CDFG 1993).

This region is primarily in private ownership, and the role of private landowners is very important for conservation. More than 75 percent of the known California locations of 32 animal species of concern occur predominately on private lands. Examples of these species include Swainson's hawk, burrowing owl, San Pablo vole, and Buena Vista Lake shrew.

Species at Risk

The Plan development team updated vertebrate and invertebrate species information in the California Natural Diversity Database (CNDDB) during 2004–2005. The following regional summary of numbers of wildlife species, **endemic** species, and **species at risk** is derived from the updated CNDDB.

There are 490 vertebrate species that inhabit the Central Valley and Bay-Delta Region at some point in their life cycle, including 279 birds, 88 mammals, 40 reptiles, 18 amphibians, and 65 fish. Of the total vertebrate species that inhabit this region, 80 bird **taxa**, 38 mammalian taxa, 11 reptilian taxa, six amphibian taxa, and 25 fish taxa are included on the California Department of Fish and Game's **Special Animals List**. Of these, 20 are endemic to the Central Valley and Bay-Delta Region, and 28 other species found here are endemic to California but not restricted to this region (Table 14.1).

Table 14.1: State-Endemic Special Status Vertebrates of the Central Valley and Bay-Delta Region

	Ambystoma californiense	California tiger salamander
	Ammospermophilus nelsoni	Nelson's antelope squirrel
	Anniella pulchra pulchra	Silvery legless lizard
	Archoplites interruptus	Sacramento perch
	Charina umbratica	Southern rubber boa
*	*Dipodomys californicus eximius*	Marysville California kangaroo rat
	Dipodomys heermanni berkeleyensis	Berkeley kangaroo rat
	Dipodomys heermanni dixoni	Merced kangaroo rat
	Dipodomys ingens	Giant kangaroo rat
	Dipodomys nitratoides brevinasus	Short-nosed kangaroo rat
*	*Dipodomys nitratoides exilis*	Fresno kangaroo rat
*	*Dipodomys nitratoides nitratoides*	Tipton kangaroo rat
	Dipodomys venustus venustus	Santa Cruz kangaroo rat

	Ensatina eschscholtzii croceator	Yellow-blotched salamander
	Eucyclogobius newberryi	Tidewater goby
	Gambelia sila	Blunt-nosed leopard lizard
	Geothlypis trichas sinuosa	Saltmarsh common yellowthroat
*	*Hypomesus transpacificus*	Delta smelt
	Hysterocarpus traski traski	Sacramento-San Joaquin tule perch
*	*Lampetra hubbsi*	Kern brook lamprey
*	*Lavinia exilicauda exilicauda*	Central Valley hitch
	Lavinia symmetricus ssp. 1	San Joaquin roach
	Masticophis flagellum ruddocki	San Joaquin whipsnake
	Masticophis lateralis euryxanthus	Alameda whipsnake
*	*Melospiza melodia maxillaris*	Suisun song sparrow
*	*Melospiza melodia pusillula*	Alameda song sparrow
*	*Melospiza melodia samuelis*	San Pablo song sparrow
*	*Microtus californicus sanpabloensis*	San Pablo vole
	Mylopharodon conocephalus	Hardhead
*	*Neotoma fuscipes riparia*	Riparian (=San Joaquin Valley) woodrat
	Onychomys torridus tularensis	Tulare grasshopper mouse
	Perognathus alticolus inexpectatus	Tehachapi pocket mouse
	Perognathus inornatus inornatus	San Joaquin pocket mouse
	Perognathus inornatus neglectus	McKittrick pocket mouse
*	*Pogonichthys macrolepidotus*	Sacramento splittail
	Rallus longirostris obsoletus	California clapper rail
	Reithrodontomys raviventris	Salt-marsh harvest mouse
*	*Scapanus latimanus insularis*	Angel Island mole
*	*Scapanus latimanus parvus*	Alameda Island mole
*	*Sorex ornatus relictus*	Buena Vista Lake shrew
*	*Sorex ornatus sinuosus*	Suisun shrew
*	*Sorex vagrans halicoetes*	Salt-marsh wandering shrew
*	*Sylvilagus bachmani riparius*	Riparian brush rabbit
	Tamias speciosus callipeplus	Mount Pinos chipmunk
*	*Thamnophis gigas*	Giant garter snake
	Thamnophis sirtalis tetrataenia	San Francisco garter snake
*	*Toxostoma lecontei macmillanorum*	San Joaquin Le Conte's thrasher
	Vulpes macrotis mutica	San Joaquin kit fox

* denotes taxon is endemic to region

The number of arthropod species is so great, and they are so poorly known taxonomically, that it is presently impossible to accurately estimate the total number of invertebrate species occurring in the state. In the Central Valley and Bay-Delta region, however, 63 invertebrate taxa are included on the Special Animals List, including 58 arthropod taxa and five mollusk taxa. Of these, 26 are endemic to the Central Valley and Bay-Delta Region, and 32 other taxa found here are endemic to California but not restricted to this Region (Table 14.2).

Table 14.2: State-Endemic Special Status Invertebrates of the Central Valley and Bay-Delta Region

	Adela oplerella	Opler's longhorn moth
	Aegialia concinna	Ciervo aegilian scarab beetle
	Andrena blennospermatis	Vernal pool andrenid bee
	Andrena macswaini	An andrenid bee
	Andrena subapasta	An andrenid bee
	Anthicus sacramento	Sacramento anthicid beetle
*	*Apodemia mormo langei*	Lange's metalmark butterfly
*	*Banksula incredula*	Incredible banksula harvestman
*	*Branchinecta conservatio*	Conservancy fairy shrimp
	Branchinecta longiantenna	Longhorn fairy shrimp
	Branchinecta mesovallensis	Midvalley fairy shrimp
	Caecidotea tomalensis	Tomales isopod
*	*Calicina breva*	A harvestman; no common name
*	*Calicina diminua*	A harvestman; no common name
	Chrysis tularensis	Tulare chrysidid wasp
*	*Cicindela hirticollis abrupta*	Sacramento Valley tiger beetle
*	*Cicindela tranquebarica n. ssp.*	San Joaquin tiger beetle
	Coelus gracilis	San Joaquin dune beetle
	Desmocerus californicus dimorphus	Valley elderberry longhorn beetle
*	*Dufourea stagei*	Stage's dufourea bee
*	*Efferia antiochi*	Antioch efferian robberfly
*	*Elaphrus viridis*	Delta green ground beetle
	Euphydryas editha bayensis	Bay checkerspot butterfly
*	*Helminthoglypta callistoderma*	Kern shoulderband snail
*	*Helminthoglypta nickliniana bridgesi*	Bridges' coast range shoulderband snail
	Hydrochara rickseckeri	Ricksecker's water scavenger beetle
	Hydroporus leechi	Leech's skyline diving beetle
*	*Hygrotus curvipes*	Curved-foot hygrotus diving beetle
	Icaricia icarioides missionensis	Mission blue butterfly
*	*Idiostatus middlekauffi*	Middlekauff's shieldback katydid
	Incisalia mossii bayensis	San Bruno elfin butterfly

*	*Ischnura gemina*	San Francisco forktail damselfly
	Lanx patelloides	Kneecap lanx
	Lepidurus packardi	Vernal pool tadpole shrimp
	Lichnanthe ursina	Bumblebee scarab beetle
	Linderiella occidentalis	California linderiella
	Lytta hoppingi	Hopping's blister beetle
	Lytta moesta	Moestan blister beetle
	Lytta molesta	Molestan blister beetle
	Lytta morrisoni	Morrison's blister beetle
*	*Metapogon hurdi*	Hurd's metapogon robberfly
	Microcina homi	Hom's micro-blind harvestman
*	*Microcina jungi*	Jung's micro-blind harvestman
*	*Microcina leei*	Lee's micro-blind harvestman
*	*Microcina lumi*	Lum's micro-blind harvestman
*	*Microcina tiburona*	Tiburon micro-blind harvestman
*	*Myrmosula pacifica*	Antioch multilid wasp
	Nothochrysa californica	San Francisco lacewing
*	*Perdita scituta antiochensis*	Antioch andrenid bee
*	*Saldula usingeri*	Wilbur Springs shorebug
*	*Speyeria callippe callippe*	Callippe silverspot butterfly
	Speyeria zerene myrtleae	Myrtle's silverspot
*	*Sphecodogastra antiochensis*	Antioch sphecodogastra bee
	Syncaris pacifica	California freshwater shrimp
	Talanites moodyae	Moody's gnaphosid spider
*	*Talanites ubicki*	Ubick's gnaphosid spider
	Trachusa gummifera	A megachilid bee; no common name
	Tryonia imitator	Mimic tryonia (=California brackishwater snail)

* denotes taxon is endemic to region

The Wildlife Species Matrix, including data on listing status, habitat association, and population trend for each vertebrate and invertebrate species included on the Special Animals List, is available on the Web at http://www.dfg.ca.gov/habitats/wdp/matrix_search.asp. For vertebrates, the matrix also includes links to species-level range maps. Additionally, a link to the California Department of Fish and Game's online Field Survey Form is available to assist in reporting positive sightings of species on the Special Animals List to the California Natural Diversity Database (CNDDB).

Three Species at Risk

Note: *The following discussion of three species at risk illustrates how stressors or threats affect species and highlights conservation challenges and opportunities. These species discussions are not intended to imply that conservation should have a single-species approach.*

Central Valley spring-run chinook salmon provides a good example of a species that faces many interacting stressors, that depends on a variety of complementary conservation approaches, and that represents the aquatic environment. Like the chinook, Swainson's hawk represents another wide-ranging, migratory species that can persist in a matrix of natural and agricultural lands. As a terrestrial species, the hawk faces a different set of stressors and helps highlight the loss of native grasslands and riparian habitats. Both species illustrate the important role of regional planning, private land conservation, and coordination among adjacent landowners. The third species, the Tulare grasshopper mouse, contrasts considerably with the previous two species in several ways and illustrates the variety of conservation situations in which at-risk species find themselves. This mouse requires native habitat exclusively and cannot live in disturbed lands. It is representative of a habitat that may lack the public appeal of riparian and other habitats but one that is nonetheless host to many at-risk species. Moreover, it also illustrates the lack of available knowledge about a given species, knowledge that is essential for making wise conservation decisions.

Spring-run Chinook

Peter Moyle

Central Valley spring-run chinook salmon is one of five distinctive "runs" or "stocks" of chinook in California, each recognized by differences in genetics and life history characteristics. Although four chinook runs use the Central Valley river system, they do so at distinctly different times of the year (fall run, late-fall run, winter run, and spring run), which prevents them from interbreeding (CALFED 2000, CDFG 1998c, 2004h, Moyle 2002).

Spring-run chinook migrate between freshwater streams of the Central Valley and the ocean, entering the rivers in the spring or early summer. They historically occupied approximately 2,000 miles of river habitat in headwaters of all major river systems in the Central Valley, and fish were able to ascend the Sacramento River as far as Mt. Shasta City and Fall River, north of Mt. Lassen. Until 1940, the Central Valley run was as large as 600,000 fish, and the San Joaquin River once supported a population of 50,000 fish, which at times may have exceeded 200,000 fish.

Spring-run chinook need deep, cold pools in headwater streams to wait in until they spawn in the early fall. Successful spawning depends on gravelly river bottoms for water circulation around eggs. Juvenile survival depends on cool water temperature and adequate dissolved oxygen in the water. As river flows increase during the winter and spring, turbidity increases, water temperatures drop, and juveniles move downstream. Once on the valley floor, fish historically moved into floodplains during high water, where they found warmer temperatures, greater food for rapid growth, and protective cover from predators. Most of the juveniles migrate to the ocean in spring, where they stay from one to five years. Their complicated life history makes it challenging to detect the success of conservation actions over shorter periods.

The single biggest cause for the decline of this fish has been the construction of dams and diversions. By the 1940s, completion of Shasta and Friant dams had blocked access to many upper headwater spawning areas. Water diversion in the San Joaquin River eliminated the run of spring-run chinook in that river. By 1997, spring-run chinook populations had declined to fewer than 1 percent of their historic population levels. Approximately 80 percent of historical spring-run habitat is now no longer accessible, and the fish's current distribution is the Feather River below Oroville Dam, the Yuba River, and Clear, Mill, Deer, and Butte creeks.

In addition to blocking access to upstream habitats, dams and diversions alter river flows, increase water temperatures, trap and kill fish (entrainment), and change the hydrological dynamics needed to maintain gravel beds and channel configurations. In the south Delta, juvenile fish are also exposed to altered river flows and salinity gradients resulting from strong pumping action in the southern Delta for large water exports to Southern California. This reverse flow confuses fish attempting to reach the ocean or natal streams and diverts them toward the major pumps.

Other factors that have contributed to the decline include loss of floodplain, riparian, and estuarine habitat due to diking, draining, and flood-control actions, increased predation on juveniles (particularly by introduced predatory fish), and regional climatic fluctuations in the Pacific Ocean.

Many actions are under way to improve conditions for spring-run chinook and for the river systems overall. The California Bay-Delta Authority has a lead role in coordinating many agencies to modify the operations of Delta pumps and major dams to improve conditions and habitat for chinook and other aquatic species. This Authority, based out of the California Resources Agency, oversees a broad, interagency effort to address water-related issues called the CALFED Bay-Delta Program. The California Department of Fish and Game is the lead agency for implementing this program's Ecosystem Restoration Plan.

Recovery actions, including habitat restoration and screening of diversion pumps, are also under way by the Central Valley Project Improvement Act Program (CVPIA—Anadromous Fish Restoration Program) and National Oceanic and Atmospheric Administration's (NOAA) Fisheries Service (previously the National Marine Fisheries Service). Restoration activities address stream flows, water temperatures, gravel supply, floodplains, meander zones, riparian habitat, wetlands, and the direction and velocity of flows in the Delta.

Ecological research on the Bay-Delta ecosystem is being carried out by many agencies. One key program is the Interagency Ecological Program, which has been conducting such research in the Delta for several decades.

Other types of conservation actions are benefiting spring-run chinook, which was state listed as a threatened species in 1998 and federally listed in 1999. Improved regulations on ocean harvest and inland fishing now provide greater legal protection for the fish. Watershed planning that involves agencies and local groups is starting to improve water quality, riparian habitat, and fish passage in headwaters. Technical assistance programs are helping farmers to minimize soil erosion and toxic discharges in drainage water.

Despite the progress being made by these efforts, more work is still needed to restore spring-run chinook populations to self-sustaining levels. This work should include:

- continuing to remove passage barriers, such as dams and other structures;
- reestablishing natural flow and temperature regimes in rivers;
- restoring riverine and floodplain habitats and ecological processes;
- improving and enforcing fishing regulations and hatchery practices;
- reducing **nonpoint** source pollution from cities and agricultural areas;
- controlling predators where chinook are most vulnerable; and
- restoring runs to streams where they have been eliminated.

Richard Hall

Swainson's Hawk

The Swainson's hawk is unusual among hawks in the West in that it feeds on insects much of the year, is gregarious, and migrates long distances between North and South America. This hawk historically bred throughout much of California, as well as other places in the West, with California population estimates ranging as high as 17,000 pairs. By the 1940s, however, researchers began to document population declines of this hawk, and, by

1979, the species was nearly extirpated throughout large parts of its former range. By 1994, their population statewide had declined by more than 95 percent to approximately 800 pairs. Additional surveys are needed to document current population levels (CDFG 2005b).

Swainson's hawks in California now breed primarily in the Sacramento/Davis/Stockton region of the Central Valley and the Modoc Plateau of northeastern California. These birds require large, open grasslands with abundant prey in association with suitable nest trees. Suitable foraging areas include native grasslands or lightly grazed pastures, alfalfa and other hay crops, and certain grain and row croplands. Unsuitable foraging habitat includes vineyards, orchards, certain row crops, rice fields, corn, and cotton fields (CDFG 2005b).

The majority of Swainson's hawk territories in the Central Valley are on private lands and in riparian systems adjacent to suitable foraging habitats. Swainson's hawks often nest in proximity to riparian systems as well as in lone trees or groves of trees in agricultural fields.

The loss of agricultural lands to various residential and commercial developments is the primary threat to Swainson's hawk populations throughout California. Additional threats are loss of nesting habitat due to riverbank protection projects; conversion from agricultural crops that provide abundant foraging opportunities to crops such as vineyards and orchards, which provide fewer foraging opportunities; shooting; pesticide poisoning of prey animals and hawks on foraging and wintering grounds; competition from other raptors; and human disturbance at nest sites (CDFG 2005b).

Recent die-offs of several thousand Swainson's hawks and other raptors in Argentina wintering grounds have been attributed to pesticide use at agricultural fields. California birds, however, winter primarily in Mexico, rather than Argentina, and at a time of year when few or no pesticides are used on croplands (Woodbridge 1998). Thus, the risk from pesticides on the wintering grounds is substantially lower than for hawks that breed in other states.

In 1983, the Swainson's hawk was state listed as a threatened species. Conservation actions to date include regional conservation planning, habitat mitigation guidelines, and other habitat protection and restoration activities.

Regional conservation planning includes Habitat Conservation Plans and Natural Community Conservation Plans. These plans are currently under way in six counties within the Swainson's hawk range and focus on conservation of both the Swainson's hawk and other species.

Mitigation for habitat loss is covered under the California Endangered Species Act and the California Environmental Quality Act. This protection does not cover some of the primary impacts to the hawks, such as loss of agricultural foraging areas. Mitigation guidelines exist to improve conservation efforts, but these are often not sufficiently implemented. Rather than being enforceable regulations, these guidelines are advisory only, and they are not inclusive enough to cover effects on the quality (as compared to extent) of bird's habitat. A more effective Department of Fish and Game mitigation policy is needed to address the continued loss of habitat and disturbance of nest sites, particularly in the Central Valley where most of the population still exists.

The Swainson's hawk Technical Advisory Committee, an independent group made up of experts from public agencies and private organizations, provides a forum for advising and implementing conservation actions for this species. It conducts research, sponsors scientific symposia, and provides expert advice on land-use issues that affect these hawks and has developed some of the elements of a draft recovery strategy. The important conservation needs for this species include protecting suitable nesting and foraging habitat, maintaining compatible agricultural practices within 10 miles of nest sites, and eliminating major disturbances near nests during breeding periods (CDFG 2005b).

In addition to the regional conservation plans mentioned above, several other projects are conserving riparian habitat that will benefit these hawks. These include the California Bay-Delta Authority's Ecosystem Restoration Program as well as conservation and restoration at the Cosumnes River Preserve, along the American River Parkway, in state and federal wildlife refuges, and at a variety of state and local parks (Natural Resources Project Inventory 2005). Wintering grounds in Mexico are also receiving conservation attention by Partners in Flight, a public-private partnership dedicated to maintaining healthy bird populations in the United States and throughout the Western Hemisphere (Geupel 2005 pers. comm.).

This conservation attention is starting to reap benefits. The range of nesting Swainson's hawks has expanded over the past decade into the southern San Joaquin Valley, with some of the nest sites occurring on new conservation lands (Saslaw 2005 pers. comm.).

Tulare Grasshopper Mouse

As mentioned above, the Tulare grasshopper mouse is a rare species that is not listed under either the state or federal Endangered Species Act. It lives in the saltbush scrub of the southern San Joaquin Valley, along with many other at-risk species. It and other southern grasshopper mice are known as "wolves of the mouse world" because of their carnivorous diet and their "howling" to keep competing males away.

The Tulare grasshopper mouse historically ranged across the central and southern San Joaquin Valley, from the vicinity of San Benito and Madera counties south to the Tehachapi

Mountains. Currently, Tulare grasshopper mice are known to occur only in scattered locations across this range. Despite the presence of several large blocks of historical habitat on the floor of the Tulare Basin and extensive trapping efforts in several of these areas, no Tulare grasshopper mice have been captured. The only recent record is the capture in 1994 of a grasshopper mouse at Allensworth Ecological Reserve.

Little is known about these mice, and much is inferred from other southern grasshopper mice. They eat mostly small animals, with insects forming the bulk of their diet. They are nocturnal and active year round. No information is known about their reproduction, mating systems, demography, or dispersal.

Tulare grasshopper mice typically inhabit arid shrubland communities in hot, arid grassland and shrubland associations, but they also occur in alkali scrub dominated by saltbush, iodine bush, mesquite, and grassland habitats. There is little information about the habitat requirements of this mouse, and there are no current overall estimates of population size for this subspecies (USFWS 1998h).

Habitat reduction, fragmentation, and degradation accompanying settlement and development of the Central Valley for agriculture are the principal causes of decline of Tulare grasshopper mice, and these continue to be major stressors. Random catastrophic events (e.g., floods, fire, and drought) combined with their low reproductive rate and other demographic indicators probably are the most significant factors in elimination of fragmented populations. However, use of insecticides (first DDT and then others, now mainly malathion) on natural lands to control beet leafhoppers could have contributed to the disappearance of grasshopper mice from fragmented islands of natural land on the Valley floor, both from direct and indirect poisoning and the reduction of insects, their staple food (USFWS 1998h).

The Tulare grasshopper mouse is not a candidate for federal listing but is considered a species of concern (USFWS 1998h). Conservation of this mouse is likely to be a part of an overall effort to conserve its habitat, which is also home to several listed kangaroo rats, the blunt-nosed leopard lizard, and the San Joaquin kit fox. The apparent elimination of this mouse from the valley floor is of greatest concern because it suggests relatively high vulnerability to extinction by random catastrophic events or from use of pesticides on even relatively large habitat areas.

Habitat protection needs for Tulare grasshopper mice are essentially the same as those for Nelson's antelope squirrels and the three subspecies of the San Joaquin kangaroo rat (USFWS 1998h). These include:

- Inventorying and assessing existing natural land (known and potential habitat) within the historical range of these species to locate populations and assess population status;
- Managing publicly owned lands and conservation lands to benefit these species;
- Protecting additional land supporting key populations;
- Regularly monitoring all populations throughout their range, or at least populations that represent the range of variation in populations, habitat conditions, and environmental variation;
- Improving understanding of the relationships and taxonomic identity of isolated populations; and
- Conducting research on habitat management and restoration, focusing primarily on how different habitat management prescriptions and restoration approaches affect the population dynamics.

Additional measures of highest priority for conservation of the Tulare grasshopper mice (USFWS 1998h) are:

- Determining the current distribution and population status of Tulare grasshopper mice on isolated blocks of historical habitat on the valley floor of the Tulare Basin;
- Analyzing the environmental features of inhabited and uninhabited fragmented islands of natural land on the Central Valley floor to determine factors, including pesticide use, that might be associated with survival and elimination;
- Establishing a rangewide monitoring program at sites representative of the range of occupied communities and areas;
- Restoring habitat and reintroducing Tulare grasshopper mice as agricultural lands are retired to natural lands;
- Including Tulare grasshopper mice in studies of management and land uses on habitat of other species of the same community associations; and
- Reevaluating the status of the Tulare grasshopper mouse within three years of recovery plan approval.

Stressors Affecting Wildlife and Habitats

- Growth and development (including urban, residential, and agricultural)
- Water management conflicts and reduced water for wildlife
- Water pollution
- Invasive species
- Climate change

Each of these stressors is significant in the loss or degradation of habitat and ecosystem processes. In aquatic environments, including wetlands and riparian, the overall amount and quality of habitat has been reduced by water management and water pollution. Invasive species are important stressors in both upland and aquatic areas. Climate change has only recently been recognized as a major stressor that is likely to have significant, long-term effects on the human and natural environment in the next few decades.

Growth and Development

The main underlying cause of habitat loss and degradation is the increasing human population and its high demand for a limited supply of land, water, and other natural resources.

Up until the last few decades, much of the terrestrial habitat loss in the region has been due to agricultural land conversion. Fig. 14.1 illustrates this historical loss of habitat, using the San Joaquin Valley as an example. Recent land-use trends show a more mixed set of pressures from both urban and agricultural land conversion, depending on the habitat, topography, and proximity to major highways. Some habitats, such as wetlands and floodplains, are receiving increased environmental protection and thus less development pressure than other habitats (Landis and Reilly 2003). On the floor of the Central Valley, urbanization occurs mostly on previously cultivated lands, where much of the habitat has already been lost or highly degraded (Fig. 14.2). In these areas, particularly in rural lands, the remaining fragments of habitat continue to be converted to intensive agriculture. In the eastern uplands and foothills of the Central Valley, urban and rural residential development has had a greater impact on habitat because it occurs generally on grasslands and other naturally vegetated lands.

The rate of population growth in the Central Valley is remarkable. Fifteen of the top 20 fastest-growing counties in California between 1990 and 2003 were in the Central Valley, all exceeding the statewide average growth rate. This pattern is likely to remain the same during the next 50 years. Between 1990 and 2003, the Central Valley gained 1.8 million residents, nearly 30 percent of the total gain statewide. By comparison, the San Francisco Bay Area gained 974,000 residents, and the Southern California coastal region gained 3 million. By 2050, the Central Valley will gain an additional 7.4 million people, exceeding the 7.1 million-person gain for Southern California and the 3.2 million-person gain of the Bay Area (CDOF 2000, 2003, 2004; Sanders 2004).

Natural habitats of this region have been converted to a variety of different land uses, including weedy pastureland, dryland farming, irrigated cropland, relatively permanent orchards and vineyards, large dairies, rural residential, and high-density urban. Wildlife species have different tolerances for each of these conversions, with many of them unable to adapt to the more-developed land uses. Beyond direct habitat loss, converting land to more intensive human-related uses brings additional stressors, including invasive species, human

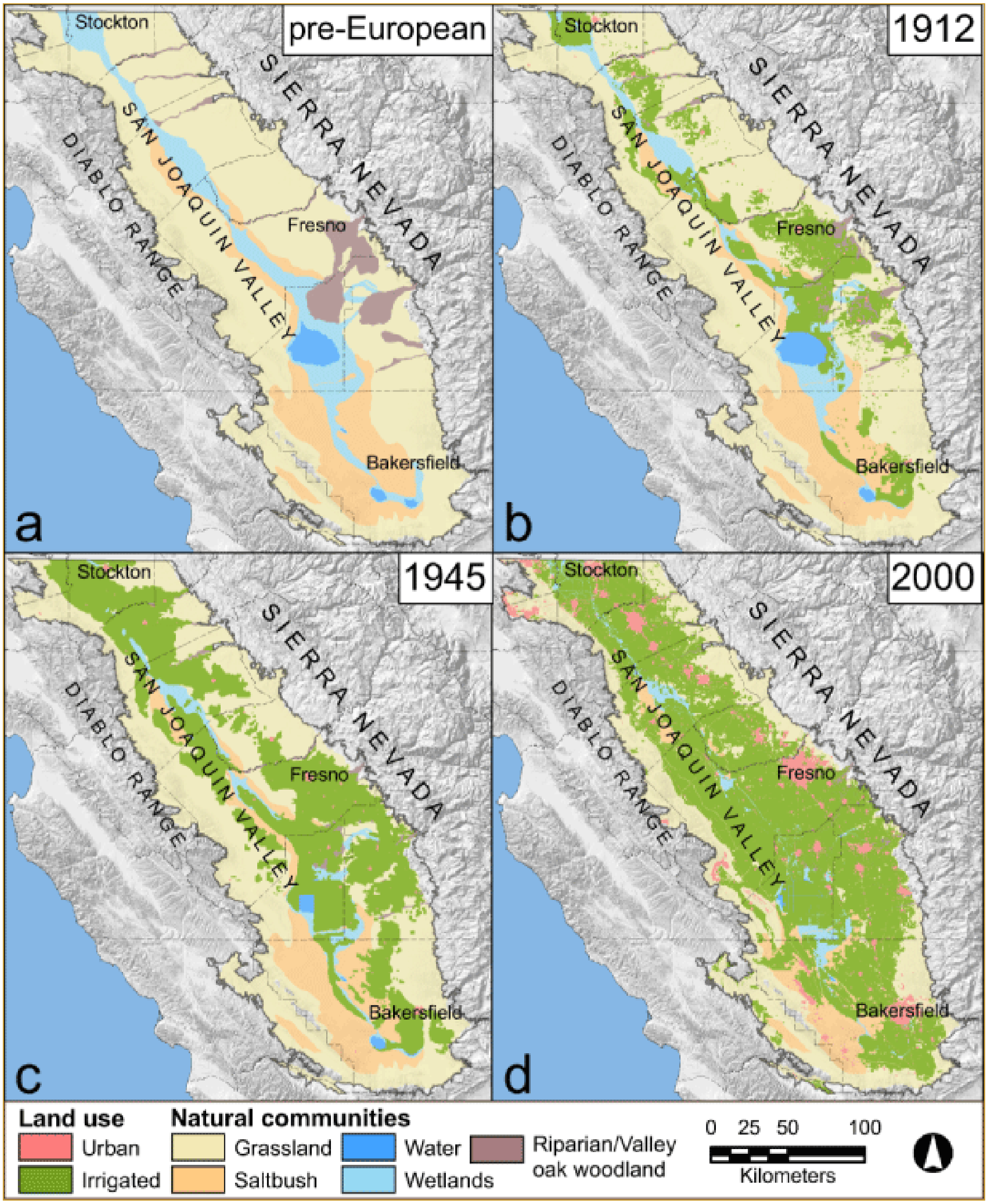


Fig. 14.1: Agricultural land conversion in the San Joaquin Valley, pre-European settlement to 2000 **(Kelly et al. 2005)**

disturbance, fire suppression, and insect control, that further degrade ecosystem health and wildlife viability.

Examples of habitat conversions include:

- In the Central Valley, 99.9 percent of the historic native grasslands, 99 percent of valley oak savanna, about 95 percent of wetlands, 89 percent of riparian woodland, 66 percent of vernal pools, and 67 percent of San Joaquin Valley shrublands are gone (CVHJV 1990, Hickey et al. 2003, Kelly et al. 2005, TNC 1987, 1995, 1998). Habitat conversion has continued since these analyses were made.
- In the Bay Area, development has removed or significantly altered 88 percent of the original moist grasslands, 84 percent of riparian forest, 80 percent of the original tidal marshes, and 40 percent of the mudflats and vernal pool complexes. Much of the loss of tidal habitats was caused by diking and filling. The bay itself has shrunk 30 percent in the last 150 years due to filling of tidal and subtidal lands (Goals Project 1999).

Growth and development fragment habitats into small patches, which cannot support as many species as larger patches can. These smaller fragments often become dominated by species more tolerant of habitat disturbance, while less-tolerant species decline. Populations of less-mobile species often decline in smaller habitat patches due to reductions in habitat quality, extreme weather events, or normal population fluctuations. Natural recovery following such declines is difficult for mobility-limited species. Such fragmentation also disrupts or alters important ecosystem functions, such as predator-prey relationships, competitive interactions, seed dispersal, plant pollination, and nutrient cycling (Bennett 1999, ELI 2003).

Growth and development, along with associated linear structures like roads, canals, and power lines, impede or prevent movement of a variety of animals. This is generally less significant than habitat loss but makes it more difficult for those species that need to move large distances in search of food, shelter, and breeding or rearing habitat and to escape competitors and predators. Animals restricted to the ground, like mammals, reptiles, and amphibians, face such obstacles as roads, canals, and new gaps in habitats. Attempts to cross these obstacles can be deadly, depending on the species and the nature of the gap (four-lane highways with concrete median barriers compared to narrow, rural two-lane roads, for example). Fish and other water-bound aquatic species attempting to move either upstream or downstream are blocked by lack of water resulting from diversions, physical barriers like dams, and by entrainment in diverted water. Even the movement of highly mobile species like birds and bats can be impeded by such features as transmission lines and wind energy farms, particularly in focused flight corridors like Altamont Pass, and 50 new wind energy sites are currently proposed throughout the state on land managed by the Bureau of Land Management (Bolster

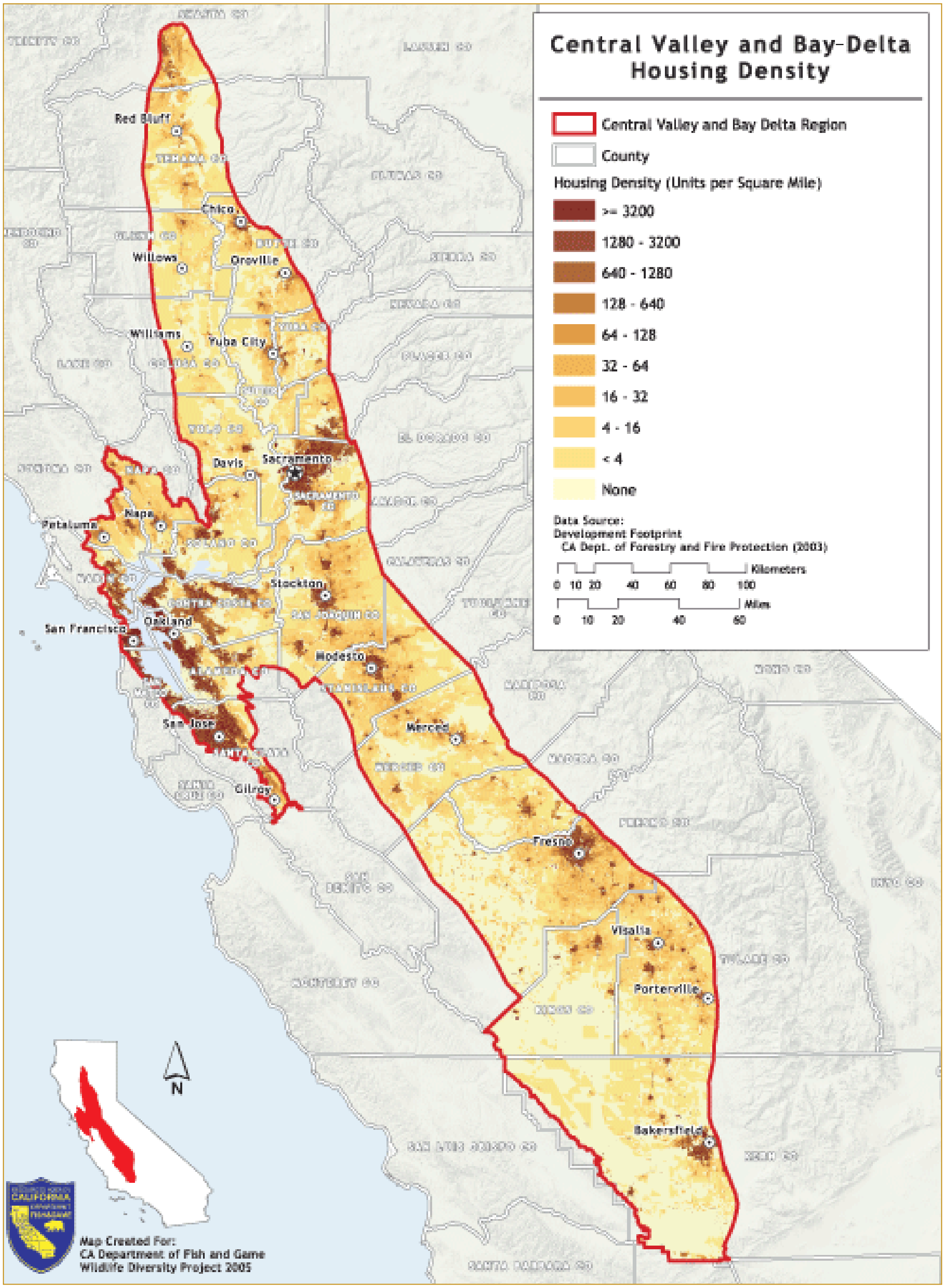


Fig. 14.2: Existing Growth and Development in the Central Valley and Bay-Delta Region
Although most of this region is in agriculture, much of it has also developed into either urban or rural residential uses, as shown by U.S. Census housing density data.

2005 pers. comm.) Such species either cannot see or do not avoid these structures, and many die as a result. The actual extent of bird fatalities due to power-line collision in California is unknown. However, the California Energy Commission estimates that fatality rates due to Central Valley power-line collisions alone could reach as high as 300,000 birds per year (CEC 2002a, 2002b).

Water Management Conflicts and Reduced Water for Wildlife

Water management stressors include water diversions, dams, flood control structures (e.g., levees and bank protection), groundwater pumping, stream and river crossings (e.g., culverts, bridges), and dredging. Managing these stressors is a major element of the California Bay-Delta Authority's Ecosystem Restoration Program (CALFED 2000, 2004a).

Water diversions are found throughout the Central Valley's rivers and tributaries, the Delta, and San Francisco Bay. Water is diverted for agriculture, municipal and industrial uses, and managed wetlands. Up to 70 percent of the freshwater flow that would naturally enter San Francisco Bay is now diverted (Steere and Schaefer 2001). Dams are located on all of the major rivers in the Central Valley and on many of their tributaries (Fig. 14.3).

Dams and diversions have dramatically affected the aquatic ecosystems of the Central Valley, altering historical flooding regimes, erosion, and deposition of sediments that maintain floodplains. They also decrease riparian habitats and coarse gravel supplies needed for salmon reproduction. Dam operations create rapid changes in flow rates that have led to the stranding of fish and exposure of fish spawning areas (Brown 2004 pers. comm.).

Dams reduce the amount of water remaining in the river that is needed by fish at critical times, and they alter the flow regimes in ways that are detrimental to aquatic life. Less water in the rivers also means less water for managed wetlands. Reduced river flows downstream also allow saltwater intrusion into the Delta, increasing the salinity levels in the San Francisco estuary and bay beyond the tolerance levels of many species (Steere and Schaefer 2001).

Agricultural diversions usually get the highest-quality water, discharging salty water that is then used in wildlife areas. By the time it is discharged from some wildlife areas, its salinity triggers concerns about water quality by regulatory agencies, particularly in the San Joaquin Valley. Efforts to correct this problem are complicated, owing to a poor understanding of the historic elements of salinity and the naturally saline wetlands of the San Joaquin drainage (Single et al. 2004 group interview).

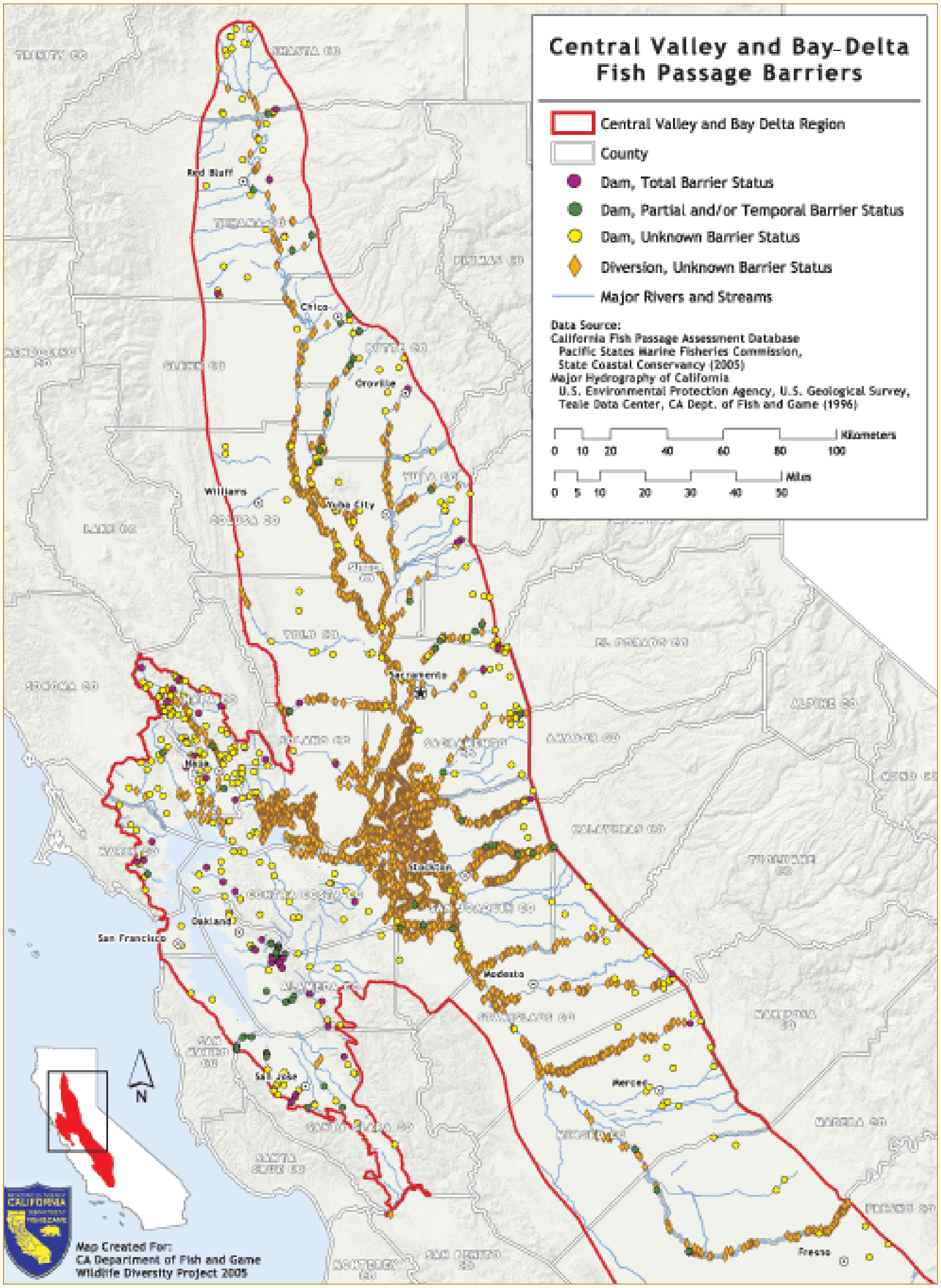


Fig. 14.3: Known Fish-passage Barriers in the Central Valley and Bay–Delta
All of the major creeks and rivers in the Central Valley and Bay Area are either dammed or diverted. Diversions are more abundant along rivers in the valleys. Dams are more common at the edge of the Central Valley, where topography more easily allows the creation of reservoirs.

Dams and diversions also block fish movement to upstream habitat, remove fish and wildlife habitat, alter water quality (i.e., temperature and flow), and kill fish through entrainment and entrapment. Dams have cut off salmon access to 95 percent of their historical range (State Lands Commission 1993, TPL 2001). The diversion of water through powerful pumps from the Delta to the canals heading to Southern California reverses Delta flows and confuses migrating fish trying to find their way to the ocean. At times, the young fish swim with the flowing waters toward the pumps rather than toward the open ocean.

Levee, bridge, and bank-protection structures are present along more than 2,600 miles of rivers in the Central Valley and in the Delta (DWR 2005a). These structures prevent flood flows from entering historic floodplains and eliminate or alter the character of floodplain habitats, such as shaded riverine habitat, and floodplain ecosystem processes. Constrained flood-level flows increase scouring and incision of river channels and reduce or halt the formation of riparian habitat, channel meanders, and river oxbow channels.

These changes in water supply also stress many upland species. Most of the resident terrestrial animals need to find adequate water for drinking during California's long, dry summer months. As human demand for water increases, there is less water available for resident wildlife species, and thus they experience greater physiological stress. In some cases, though, water management has led to sustained year-round flows in streams that historically dried up in the summer.

One important difference between the Bay Area and the Central Valley is the geographic drainage areas of watersheds and the role of water transfers. Except for estuarine habitats that are influenced by flows from the Delta, most of the habitats in the Bay Area depend on relatively small, local watersheds. Central Valley habitats rely on a much larger and complex drainage, involving snowmelt and land use up to 300 miles away and water imports from and exports to other major river basins. Thus, although local watershed efforts are important in both subregions, they can have a more direct influence on reducing water-related stressors in the Bay Area for the same level of effort.

Current water management practices exemplify how several of these stressors interact. As urban development expands, it creates more impermeable surfaces like concrete, asphalt, and the roofs of buildings. Subsequent rainfall is then less able to soak into the ground and runs off quickly. Rapid runoff reduces the recharge of groundwater reservoirs and reduces later summer stream flows. Combined with water diversions, this reduction in groundwater causes streams to dry up more quickly, thus reducing the availability of water to wildlife during summer months. Increased urban runoff also is a major source of water pollution (described below). It washes various pollutants out of urban areas, depositing them into creeks, rivers, and other water bodies, adding to wildlife stress.

Water Pollution

Up to 40,000 tons of contaminants enter the Bay-Delta annually. Four types of water contaminants affect wildlife in the Bay-Delta:

- inorganic compounds such as heavy metals, phosphates, and nitrates from municipal wastewater, industrial effluent, agricultural and mine drainage, and urban runoff;
- organic compounds such as polychlorinated biphenyls (PCBs), pesticides, fertilizers, and detergents from urban and agricultural runoff;
- biological contaminants, such as viruses and bacteria from sewage, farm, dairy, and feedlot runoff, and from urban runoff; and
- other toxins that originate from a variety of sources, some of which are unknown.

The most significant toxins are diazinon, mercury, PCBs, chlorpyrifos, and boron. These pollutants or conditions are present in hundreds of miles of streams and most estuarine waters throughout the Bay, Delta, and Central Valley (see Fig. 14.4). Other important factors that impair water quality include increased levels of nutrients, pathogens, low levels of dissolved oxygen in water, and sedimentation (SWRCB 2002a).

Mercury contamination has become a major concern for wildlife conservation in the Bay-Delta region, and high mercury concentrations in Bay fish pose a human health risk. The pathways of mercury uptake from the environment are poorly understood, which exacerbates the problem. Ongoing inputs from the watershed and historical deposits of mercury from the gold-mining days are of concern, particularly as ecosystem restoration efforts proceed. The primary concern is that large-scale wetland restoration may transform residual mercury into a chemical form more easily taken up by clams, fish, birds, and other estuarine life, with potential sublethal effects for them and health risks for any humans consuming contaminated fish (CALFED 2003).

Pollutants reduce dissolved oxygen in Delta waterways, stressing aquatic species. One source of low dissolved oxygen levels is water that drains from some of the managed wetlands, such as in the Suisun Marsh. These operations flood fields for waterfowl, and the floodwaters then soak up organic matter. The resulting "black water" that drains out of the fields is very low in dissolved oxygen and causes fish kills in some localized areas. Although this problem has been known for many years, little action has been taken to correct it (Moyle 2002). Similar to the salinity issue mentioned above, too little is known about historic base-

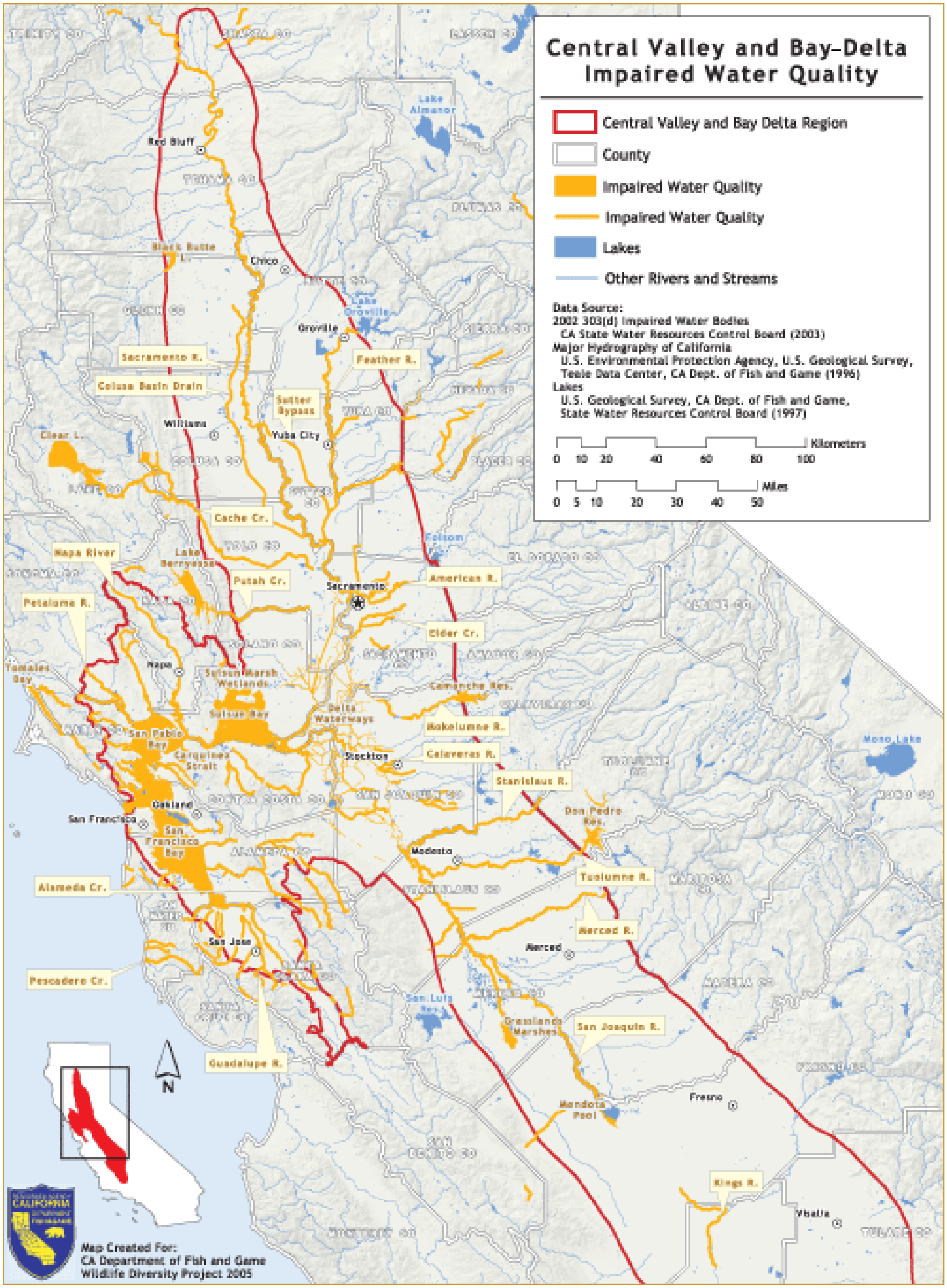


Fig. 14.4: Impaired Water Quality in the Central Valley and Bay-Delta

Water contaminants include organic and inorganic compounds, biological contaminants, and other toxins.

line conditions of dissolved oxygen in Delta waterways, and coherent decisions on integrated land and water management have not been made. The overall system of actions and conditions affecting water quality is quite complex and is only beginning to be understood.

Invasive Species

Invasive plant and animal species are an important stressor on wildlife in this region, just as they are in other regions throughout the state (CALFED 2000, CalIPC 1999, CDFG 2005, Goals Project 1999, Hickey et al. 2003, Jurek 1994, Lewis et al. 1993, RHJV 2004).

Invasive plants can be found in many different habitats in this region. In grasslands, some of the more challenging plant invaders include eucalyptus, fountain grass, gorse, medusahead, tree of heaven, and yellow starthistle. In riparian and wetland areas, invading plants include edible fig, giant reed or arundo, Himalayan blackberry, pampas grass, Russian olive, tamarisk (or saltcedar), pennyroyal, peppergrass and tree of heaven. Smooth cordgrass is a major concern in salt marshes. Oak woodlands are invaded by plants such as Scotch broom and French broom. Coastal habitats face alien species such as gorse, iceplant, and pampas grass.

Introduced plants also invade aquatic habitats. These aquatic invaders include Brazilian waterweed, egeria, Eurasian watermilfoil, hydrilla, water hyacinth, water pennywort, and parrot feather.

Introduced animals have invaded both terrestrial and aquatic environments. Sixty-four non-native terrestrial animal species have invaded California wildlands, including brown-headed cowbirds, European starlings, domestic dogs and cats, introduced red foxes, Norway rats, and feral pigs (Grenfell et al. 2003). Not all introduced vertebrates are invasive, and they have varying effects on wildlife. The species of most concern in the region parasitize songbird nests, dominate limited nesting habitat, prey on native species, or otherwise damage wildlife habitats.

Fifty-one new fish species have become established in California (Moyle 2002), dominating most of the rivers and streams in this region. These include species such as striped bass, white catfish, channel catfish, American shad, black crappie, largemouth bass, and bluegill. Many fish were historically introduced and continue to be introduced (planted) by federal and state resource agencies to provide sport fishing or forage fish to feed sport fish. Introduced fish out-compete native fish for food or space, prey on native fish (especially in early life stages), change the structure of aquatic habitats (increasing turbidity, for example, by their behaviors), and may spread diseases (Moyle 2002). Several of the introduced predatory fish have increased predation levels on chinook salmon (CALFED 2000).

In addition to introduced fish, native aquatic species are stressed by introduced bullfrogs, red-eared sliders (a turtle), and invertebrates. Introduced invertebrates, such as Asian clam, zebra mussel, Chinese mitten crab, and mysid shrimp, are causing significant problems for native species in rivers, streams, sloughs, and the San Francisco estuary. The introduction of species via discharge of ship ballast water in San Francisco Bay has created one of the most invaded estuaries in the world (CALFED 2000). Most of the clams, worms, and other bottom-dwelling invertebrates presently inhabiting the Bay-Delta have been introduced from other estuaries. This biological invasion continues, with a new species introduced roughly every 14 weeks (CALFED 2000). While not all of the introduced aquatic species are invasive or have significant consequences for native species, biologists are concerned about the sheer dominance of these new species and their current and potential effects on the structure and function of the estuarine ecosystem.

Climate Change

Although climate change is already affecting wildlife throughout the state (Parmesan and Galbraith 2004), and its effects will continue to increase, it has particular significance for this region's major river and estuarine systems.

In general, California winters will likely become warmer and wetter during the next century. Instead of deep winter snowpacks that nourish valley rivers through the long, dry summer, most of the precipitation will be winter rain that runs off quickly. For the Central Valley and the Bay, this means more intense winter flooding, greater erosion of riparian habitats, and increased sedimentation in wetland habitats (Field et al. 1999, Hayhoe et al. 2004).

Hotter, drier summers, combined with lower river flows, will dramatically increase the water needs of both people and wildlife. This is likely to translate into less water for wildlife, especially fish and wetland species. Lower river flows will allow saltwater intrusion into the Bay and Delta, increasing salinity and disrupting the complex food web of the estuary. Water contaminants may accumulate during the summer as the natural flushing action decreases.

Sea level worldwide during the past 100 years has been rising from 1 to 2 millimeters per year, 10 times faster than the rate over the past 3,000 years. Gauges along the California coast have already measured 4-inch to 6-inch increases in sea level since 1900 (NOAA 2005). By 2100, sea levels might rise as high as 3 feet above their present levels (ACIA 2004, IPCC 2001).

This is especially significant in the San Francisco Bay Area and the Delta, where much of the land has subsided to below sea level and is currently protected from flooding by levees. Fig. 14.5 shows those lands that are fewer than 3 feet above sea level in the Bay and Delta area.

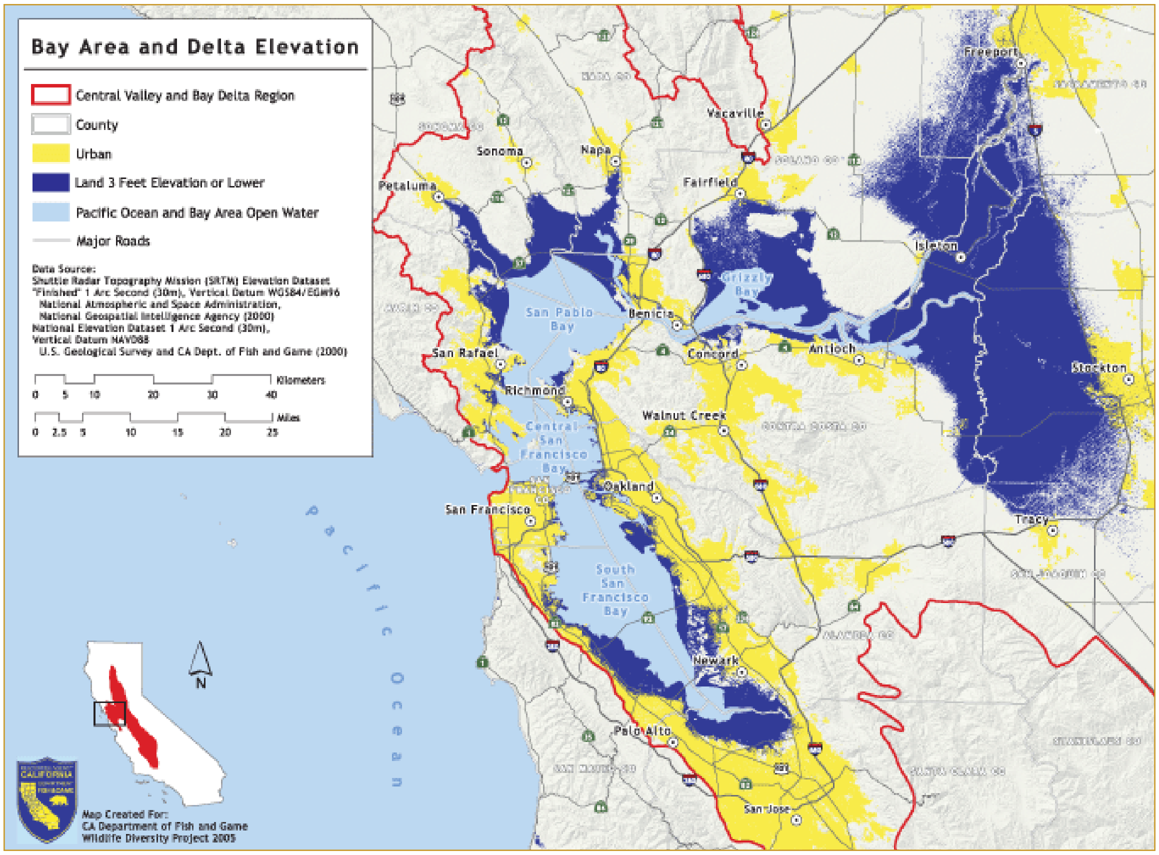


Fig. 14.5: Lands in the Delta below 3 Feet of Elevation
Much of the Delta and large sections along the San Francisco Bay shoreline are below 3 feet of elevation. Sea level rise due to climate change could flood these areas with saltwater. Existing levees and other flood barriers that protect lands below sea level are too small to display at this map scale. Anomalies in digital elevation data may overestimate or underestimate the actual acreage of these lands by up to 15 percent in some areas.

Continuation of current farming practices will worsen this subsidence throughout much of the Delta. This increased subsidence, combined with higher sea level, increased winter river flooding, and more intense winter storms, will significantly increase the hydraulic forces on the levees. Given their current state, a powerful earthquake in the region could collapse levees, leading to major seawater intrusion and flooding throughout the Delta (Mount and Twiss 2005).

Even without levee collapse, the sea-level rise alone could make conditions unsuitable for pumping freshwater through the Delta channels for the major water-export pumps. Continued water exports might need an alternative freshwater conveyance facility for the Delta to circumvent this saltwater intrusion. The consequences of sea-level rise are also likely to occur in the Bay Area, where tidal wetlands that are currently squeezed between urban lands and the sea will no longer be able to persist (CEC 2005, DWR 2004, Field et al. 1999, Shaw 2002).

The ecological functioning of upland habitats is likely to be disrupted as individual species respond differently to climatic changes. Some species will likely adapt in place, others will probably move to better climates, and the rest will experience different rates of population or health declines. Movement to other habitats will be more challenging as the few remaining habitat patches shrink and the gaps between habitats grow.

Conservation Actions to Restore and Conserve Wildlife

In addition to the recommended regional actions described below, see the recommended statewide conservation actions as given in Chapter 4.

a. The California Resources Agency, Fish and Game, the U.S. Fish and Wildlife Service, public land managing agencies, and local governments need to develop multicounty regional habitat conservation and restoration plans.

See Statewide Actions a and c in Chapter 4.

Much of the conservation planning in this region occurs either at the county scale or smaller or focuses on only a subset of wildlife issues (e.g., bird conservation plans, recovery plans) with little integration among them.

Regional conservation plans need to integrate with state-level or regional plans for housing, transportation, energy, water, and other infrastructure that provide opportunities or constraints for conservation.

Many of the recommendations elsewhere in this chapter need to be part of this regional planning, including managing across ownership boundaries, targeting landowner assistance programs, restoring habitats, ensuring reliable water for wildlife use, and controlling invasive species.

The Baylands Ecosystem Habitat Goals report (Goals Project 1999) provides a good example of regional assessment and planning; it created the basis for the bayland conservation efforts of the San Francisco Bay Joint Venture and its many partners. Conservation interests in the Bay Area have started to build upon this type of approach to cover upland habitats and wildlife needs, although this effort currently lacks sufficient funding. Similar goal-setting efforts need to be developed in other watersheds throughout the region to form a stronger foundation for conservation decisions (Collins 2005 pers. comm.).

The California Bay-Delta Authority's Ecosystem Restoration Program views integrated regional plans as its next important phase. The most developed of these is the Delta Regional Ecosystem Restoration Implementation Plan. Plans are being initiated in Suisun Marsh and along the Sacramento River. Other regions under consideration include the Bay Area and the San Joaquin Valley (Jacobs 2004 pers. comm.). The California Bay-Delta Authority needs to ensure that these plans go beyond the organization's aquatic focus and integrate its recommendations with other, overlapping upland conservation plans.

b. While numerous private landowners are leaders in conservation, Fish and Game, the U.S. Fish and Wildlife Service, the USDA Natural Resources Conservation Service, and local resource conservation districts need to improve conservation and restoration on private lands by assisting private landowners.

See Statewide Action h in Chapter 4.

The vast majority of land in the Central Valley and Bay Area is in private ownership. Agencies and conservation organizations are unlikely to protect all of the important areas for wildlife in this region by use of acquisition, easements, and regulatory approaches alone. Landowners need to be encouraged to provide wildlife habitat on their lands and reduce their cumulative stresses on wildlife through voluntary programs. Assisting private landowners requires recognizing the varied types of landowners in this region, understanding the major challenges to private land conservation, and finding ways to overcome these challenges (see Fig. 14.6, Conservation Assistance to Private Landowners).

While the participation of willing landowners is critical for success, assistance programs need to target their efforts in areas with high wildlife values and where enhancements are technically feasible, rather than simply being opportunistic. These programs are likely to be most successful in rural areas, away from cities. In rapidly urbanizing areas, development pressures increase land values so dramatically that assistance programs are often poor competitors for landowner attention (Chamberlin 2004 pers. comm., Environmental Defense 2000, Fischer 2004, Hummon and Casey 2004, Shaffer 2004 pers. comm.).

State and federal agencies need to strengthen, improve, and increase publicity for their existing private-landowner assistance programs. They need to better integrate these programs with one another to improve their overall effectiveness and develop state Safe Harbor-type agreements (USFWS 2002b). Safe Harbor Agreements are voluntary arrangements between the U.S. Fish and Wildlife Service or National Marine Fisheries Service and cooperating nonfederal landowners. The agreements benefit endangered and threatened species while

Fig. 14.6. Conservation Assistance to Private Landowners

Landowners have differing interests, face differing challenges, and have differing needs for conservation assistance.

Types of private landowners

- Conservation-focused (land trusts, environmental groups)
- Recreation-focused
- Farmers and ranchers (small to industrial-sized operations)
- Public utilities
- Residential (urban, suburban, small rural, large rural)
- Land or resource investors

Level of interest by landowner in both conservation and receiving assistance

- None
- Low
- Moderate
- High

Most appropriate type of assistance

Challenges facing landowners

- Inadequate owner awareness of land's biological significance
- Insufficient knowledge about wildlife needs
- Uncertainty about how to meet both wildlife needs and other objectives for the land
- Complex regulatory environment; concern about increased regulatory burden following voluntary wildlife enhancements
- Insufficient resources (time, technical, funding) to take conservation action
- Lack of motivation or incentives to encourage action
- Poor experiences with or trust of government programs

Types of assistance

- Basic information about what to conserve and how
- Public recognition (awards, signage, press)
- Technical assistance:
  - ◊ Permitting and regulations
  - ◊ Conservation practices
- Market-based approaches (conservation trading, ecotourism)
- Financial
  - ◊ Tax benefits or credits
  - ◊ Direct funding for habitat improvement

Sources: Defenders of Wildlife 2002, Environmental Defense 2000, Fischer 2004, Henson 2004, Hummon and Casey 2004, Sustainable Conservation 2004, USFWS 2002b, USFWS 2002f, USFWS 2004a giving the landowners assurances from additional restrictions. Following development of an agreement, the agency issues an "enhancement of survival" permit to authorize any necessary future incidental take and provide participating landowners with assurances that no additional restrictions will be imposed as a result of their conservation actions.

Public and private agencies should encourage conservation of grassland and shrubland habitats on private lands by promoting economically and ecologically sustainable grazing as a compatible land use. There are several important programs that provide support for working landscapes including the Environmental Quality Improvement Program, the Wildlife Habitat Improvement Program, the Grasslands Reserve Program, and Conservation Security Program.

A related form of private landowner assistance is the nurturing and support of local land conservancies and watershed groups, which can work effectively with private landowners at the local and regional level. For example, with funding from the California Resources Agency and The David and Lucile Packard Foundation, the nonprofit Sequoia Riverlands Trust purchased the Homer Ranch near the Kaweah River in the San Joaquin Valley. The land remains a working cattle ranch, but it also provides public access, public education, protection for riparian wildlife, and one of the largest remaining sycamore alluvial woodland communities in the state (Sequoia Riverlands Trust 2005).

c. Public land managers need to continue improving wildlife habitat for a variety of species on public lands.

Although this region has a relatively small public land base, public land managers have an important role to play in protecting and restoring wildlife populations and habitats. Simply because habitat is in public ownership does not necessarily mean that these lands are receiving adequate protection or management. Many additional activities beyond the initial real estate action are necessary to meet the needs of wildlife on those lands. To improve the contribution of public lands to protecting wildlife, the following actions are needed:

- Adequately fund operation and management of public lands that were established specifically for wildlife conservation. Dedicated endowments for long-term management of properties would help ensure that management funds remain available and not subject to other competing agency priorities.
- Manage wildlife areas for the full variety of habitats and species found in the area. Managers should be funded to evaluate and, where feasible, adopt the habitat management recommendations given in existing species- or habitat-specific conservation plans, which include such actions as monitoring, research, and restoration. Managers should adopt approaches that manage for both ecosystems and species of special interest or concern.

- Improve the management of large rural public lands to support functioning ecosystems and enhanced wildlife populations. In this region of limited public land, every piece of such land with native vegetation is valuable for wildlife. These lands include state and federal wildlife areas, large rural parks (national, state, or local), water-district and utility-district lands, military lands, and other public lands. Land managers should develop and implement management prescriptions that benefit wildlife, sustain populations, and reduce the effects of invasive species.

d. Public agencies and private organizations need to work with the San Francisco Bay Joint Venture to protect and restore the Bay's tidal habitats and baylands.

The most important habitats of concern around the shore of San Francisco Bay are deep and shallow bay and channel environments, tidal baylands, and diked baylands. Tidal bayland habitats include tidal flats, marshes (both salt and brackish), and lagoons. Diked bayland habitats include diked wetland, agricultural lowlands, salt ponds, and storage ponds.

Recommendations listed elsewhere in this chapter also apply to tidal and bayland habitats in San Francisco Bay, including improved easements, private landowner assistance, improved public land management, invasive species control, and improved water quality. Continued and expanded support is needed for implementing the San Francisco Bay Joint Venture's (SFBJV) detailed strategy for conserving baylands (Steere and Schaefer 2001). Building on the San Francisco Baylands Ecosystem Habitat Goals report, the SFBJV strategy provides acreage objectives for acquiring, restoring, and enhancing these habitats in each of five subregions of the Bay. It also provides recommendations for managing these habitats on both public and private lands, strengthening funding, and collaborating with other conservation programs. The SFBJV strategy needs to continue and to expand its collaboration with the San Francisco Estuary Project's Comprehensive Conservation and Management Plan for the Bay and Delta (SFEP 1993).

e. Public agencies and private organizations need to collaboratively protect and restore habitat connectivity along major rivers in the Central Valley.

See Statewide Actions d and g in Chapter 4.

Several collaborative efforts have already started to protect and restore riparian, floodplain, and other habitat along Central Valley rivers, including the Central Valley Habitat Joint Venture, the Riparian Habitat Joint Venture, the CALFED Ecosystem Restoration Program, and the Sacramento River Conservation Area Forum. Individual state, federal, and local agencies and private conservation organizations are also engaged in these types of conservation actions.

More action and funding are needed to complete or initiate conservation and restoration projects along these major rivers. The set of actions varies, depending on the location and the specific habitat or species needs, but includes habitat restoration, modification of flood control structures, acquisition or easements, and private landowner assistance. Some of the important rivers and tributaries include:

- Main stems of the Sacramento, Feather, and San Joaquin rivers;
- Tributaries of the Feather and Sacramento rivers that link the valley floor to Sierra Nevada foothills and coastal foothills;
- The Cosumnes, Calaveras, and Mokelumne rivers, linking the Delta to the Sierra Nevada foothills;
- Tributaries of the San Joaquin River that link the valley floor to Sierra Nevada foothills and coastal foothills;
- The Kings and Kern rivers and their tributaries.

f. Public agencies and private organizations need to collaboratively protect and restore upland linkages among protected areas in the San Joaquin Valley.

See Statewide Action d in Chapter 4.

Important linkages for conservation attention include:

- Linkages among protected areas of the Grasslands Ecological Area (including the San Luis National Wildlife Refuge complex and Los Banos Wildlife Area) in central Merced County;
- Linkages in the Tulare Basin among Kern and Pixley National Wildlife Refuges, Allensworth Ecological Reserve, northern Semitropic Ridge, and the western foothills;
- Linkages along the western edge of the San Joaquin Valley, including the Carrizo Plain National Monument and the Lokern Natural Area northwards to the Panoche Hills and the foothills of the Diablo Range near Tracy.

g. Public agencies and private organizations need to collaboratively protect and restore lowland linkages in San Francisco Bay.

See Statewide Action d in Chapter 4.

Important lowland linkages include:

- Linkages between tidal marshes, salt ponds, and other bayland habitats along the margin of San Francisco Bay;
- Stream corridors connecting low baylands (tidal marshes, salt ponds, etc.) throughout San Francisco Bay with upland areas, where possible. These baylands have been significantly isolated from upland areas by roads and urban development.

h. Public agencies and private organizations need to collaboratively protect upland linkages and reduce the risk of habitat isolation in the eastern and northern San Francisco Bay area.

See Statewide Action d in Chapter 4.

The rapid urbanization of the eastern and northern portions of the Bay Area is beginning to create at least four major "islands" of natural vegetation and public lands. These areas are at risk of being completely isolated from one another due to land development along major highways. As with the areas above, planners need to evaluate these areas to determine species conservation needs and appropriate types of connections to either maintain or reestablish them. Land-use planning and habitat-protection actions are needed to keep these lands connected with other natural areas. Based on a simple map-based inspection of existing patterns of natural vegetation, land use, and transportation routes, the main constriction zones are:

- Interstate 80 between Fairfield and Vallejo, where development pressure may isolate Suisun Marsh from upstream areas north of the freeway;
- Interstate 580 between Dublin and Castro Valley, where development pressure may isolate natural lands on the north (including Las Trampas Regional Park and Chabot Regional Park) from lands to the south (including Pleasanton Ridge Regional Park);
- Interstate 680 between Fremont and Pleasanton, where development pressure may isolate natural lands on the north (Pleasanton Ridge Regional Park) from natural lands to the south;
- Interstate 580 near Altamont Pass (between Livermore and Tracy), where development pressure may isolate natural lands on the north (including Mt. Diablo State Park and the Los Vaqueros watershed lands) from natural lands to the south.

i. Water management agencies need to secure dependable and adequate amounts and quality of water for wildlife.

See Statewide Action e in Chapter 4.

As California's population increases, the demand for water increases and reduces the amount left for wildlife, particularly species that are dependent on rivers and wetlands.

Wildlife areas that support wetlands (on both private and public lands) have a high demand for sufficient quantities of unpolluted water. The amount of water available to refuges varies each year and is commonly not delivered at times most needed for wetland management. Typically, refuges receive water only after all other agricultural, municipal, and industrial demands are fulfilled.

Although water for wildlife was agreed to in the Central Valley Project Improvement Act, it is insufficient to meet the needs of wildlife areas, especially as those areas strive to meet the needs of a greater variety of species. Much of the water goes for fisheries management, with inadequate amounts left over to meet the needs of other species. Additionally, water amounts have to be agreed upon in time-consuming, year-to-year negotiations (Shaffer 2004 pers. comm., Single et al. 2004 group interview).

As water prices increase, wildlife agencies and private wetland managers often cannot afford to purchase enough water and convey it to where it is needed. They have to compete against cities and agricultural interests that are able to pay higher prices in the water market. The Central Valley Habitat Joint Venture has a report that examines this issue in more detail (Shaffer 2004 pers. comm.). The Central Valley Habitat Joint Venture Implementation Plan provides more specific recommendations about water needs (CVHJV 1990), and a major update of this plan is scheduled for 2005.

- Secure legal rights for water for wildlife in perpetuity with long-term agreements. Secure sufficient amounts of adequate-quality water for wildlife areas at the appropriate seasons using long-term multiple-year contracts. One possibility is to include this as a requirement of long-term agricultural water contracts or to include in mitigation efforts (CDFG 1995, Shaffer 2004 pers. comm.).
- Reduce large water exports out of the Central Valley so that more water is available for wildlife.
- Design water-banking projects within the region to provide wetland and upland habitats for wildlife.

j. Water management agencies need to reestablish and maintain more natural river flows, flooding patterns, water temperatures, and salinity conditions to support wildlife species and habitats.

See Statewide Action g in Chapter 4.

River flows, particularly in the major rivers of the Central Valley, need to be of sufficient frequency, timing, duration, and magnitude to restore and maintain functional natural floodplain, riparian, and riverine habitats. Such flows should be able to:

- mobilize gravel bed transport;
- allow for channel migration, river meanders, and complex channel patterns; and
- provide suitable aquatic conditions, including river water temperature and estuarine salinity, for viable populations of native aquatic species.

Restoring natural flow regimes can both favor native aquatic species and reduce the impacts of invasive aquatic species.

Adequate freshwater flows in Central Valley rivers are also one of the essential components to restore and maintain a healthy and diverse estuary in the Bay Area (SFEP 1993). One of its major influences is on salinity conditions in the estuary. The saltiness of the water, and particularly its seasonal and year-to-year patterns of variability, affects which aquatic species live where within the estuary. Salinity also determines where water can and cannot be diverted for human consumption and irrigated agriculture and plays a role in determining the capacity of the estuary to cleanse itself of wastes.

k. Water management agencies need to restore gravel supply in sediment-starved rivers downstream of reservoirs to maintain functional riverine habitats.

One of the major negative effects of dams is the capture of coarse sediments that naturally would move to downstream areas. As a result, the downstream reaches become coarse-sediment starved, hardening (armoring) streambeds with fine sediments to the point where they are largely unsuitable for spawning salmon and other anadromous fish. The CALFED Ecosystem Restoration Plan (CALFED 2000) describes several important actions that are needed to improve gravel supply for fish habitat, including:

- Protecting existing natural sediment sources in river floodplains from such disturbances as bank protection, gravel mining, levees, dams, changes in stream flow, and changes to natural stream meanders;
- Artificially maintaining sediment supplies below dams;
- Increasing the availability of sediment stored in banks and riverside floodplains;
- Enhancing and restoring natural stream-bank erosion and stream meander processes;
- Increasing gravel passage through small reservoirs;
- Removing non-essential or low-value dams;
- Eliminating instream gravel mining on channels downstream of reservoirs;
- Developing incentives to discourage mining of gravel from river channels and adjacent floodplain sites;
- Developing programs for comprehensive sediment management in each watershed;
- Developing ecologically based stream-flow regulation plans.

l. Public agencies and private organizations should conserve and restore water-dependent habitats (including wetland, riparian, and estuarine) throughout the region. Design of these actions should factor in the likely effects of accelerated climate change.

See Statewide Action g in Chapter 4.

Conserving water-dependent habitats is especially important in this region because they are among the most significant wildlife areas left. These habitats include tidal habitats, shallow water sloughs, rivers and creeks, wetlands and vernal pools. Much of the water that flows through these habitats drains from uplands. Poor land-use in these higher areas can unnaturally accelerate runoff and increase sediment and contaminant loading downstream. Thus regional and watershed-based conservation actions are an essential part of the overall solution.

Conservation planning for riverine and estuarine habitats also needs to factor in the likely effects from rapid climate change. Tidal habitat conservation efforts need to include upslope room for marshes to migrate as sea level rises. Rising sea levels could obliterate current successes in tidal marsh habitat restoration. Riparian restoration along tightly controlled rivers could be washed away as the intensity of winter rains and floods increase.

Restoration is also needed to reestablish significant portions of wetlands and aquatic communities in the Tulare Lake Basin, building on the efforts of the Central Valley Habitat Joint Venture and local initiatives.

Actions to conserve and restore rivers and floodplains include:

- Discourage permanent development, such as urban uses, and encourage wildlife-compatible land uses in lands that are near sea level (within 6 feet of high tide line) and near rivers and streams. This is especially important in areas immediately upslope or inland of important tidal habitats. Acquisition of fee-title or conservation easements should be encouraged in these areas to give tidal lands room to migrate as sea level rises.
- Expand information about flood-prone areas in the California Dept. of Water Resource's nonregulatory Awareness Floodplain Mapping Program database to include all flood-prone developing areas in California. Its data need to be improved to account for future build-out and the resulting expected increase in runoff downstream. Such floodplain maps should be prepared on a watershed basis, rather than on political boundaries, using consistent mapping standards throughout each watershed. These maps should also account for current and future build-out (DWR 2002).
- Avoid development of permanent buildings in floodplains. Existing flood maps used by local government should be based on the improved Water Resources database described above.
- Expand conservation zones by setting back levees and removing riprap along all rivers and major creeks so they can freely meander and safely overflow existing channels. This will help create and maintain complex channel morphology, in-channel islands, and shallow water habitat in the Delta and Suisun Marsh; increase the extent of freely meandering reaches; promote the natural cycle of channel movement, sediment deposition, and scouring needed for a diversity of riparian vegetation types; and restore coarse sediment supplies to sediment-starved rivers downstream of reservoirs.
- Use nonstructural approaches, such as bypasses and managed floodplains, to control flooding along rivers and major creeks. An example of successful multi-objective floodplain management is in the Yolo Bypass. Although initially established for use as a floodwater corridor, it is also intensively cultivated outside the flood season, provides habitat for native fish, waterfowl and

wading birds, and provides important outdoor recreation, including wildlife viewing, hunting, and fishing. (DWR 2004, Sommer et al. 2001).

- Manage floodplains and bypasses to maximize ecosystem protection, habitat restoration, and wildlife use while still providing for public safety and flood-damage reduction. The California Floodplain Management Task Force report (DWR 2002) provides a comprehensive list of recommendations for improving floodplain management.
- Provide agricultural buffers upslope of areas likely to be damaged by changes related to climate change, including sea level rise and more catastrophic flood events.
- Maintain, restore, and improve the functional hydrological connections between upper watersheds and downstream habitats (such as wetlands, estuaries, and marine environments). Elevate roadways (an example is the Yolo Causeway) where they divide wetlands from upper watersheds to reduce habitat fragmentation between these connected habitats. Design river and stream crossings to convey sediment as well as water; this will reduce upstream flooding and downstream erosion and thus help maintain aquatic and riparian habitats. Restore surface and groundwater sources, stream channels, and natural storage places for sediment and water; this will help sustain base flows, wet meadows, and transitional habitats between rivers and tidal systems.

m. Water management agencies, state and federal wildlife agencies, and other public agencies and private organizations need to collaboratively improve fish passage by removing or modifying barriers to upstream habitat.

In some cases, improving fish passage is a matter of providing adequate water flow in streams. In other cases, it may mean modification or complete removal of dams and other obstacles to make passage easier.

The statewide inventory of barriers to fish passage (CalFish 2005) needs to be improved to identify the relative significance of different barriers and barrier types. It also needs to be expanded to include the locations of all other existing passage barriers.

State government needs to develop a comprehensive program to remove these barriers, building on the work of Water Resources' Fish Passage Improvement Program and the inter-agency Fish Passage Forum. Partnerships with nongovernmental organizations can leverage and extend the effectiveness of these programs.

Opportunities for improving fish passage exist on large rivers (e.g., the Red Bluff Diversion Dam on the Sacramento River) as well as on smaller streams. Collectively, actions on both rivers and streams can make a big contribution. These actions need to focus on strategic areas in which to make the best contribution with limited resources.

n. To support healthy aquatic ecosystems, public agencies and private organizations, in collaboration with the California Bay-Delta Authority, need to improve and maintain water quality in the major river systems of this region.

The California Bay-Delta Authority has two program elements that are interactively addressing water quality in the Sacramento and San Joaquin river systems: the Drinking Water Quality Program and the Ecosystem Restoration Program. Both programs need to implement their current multiyear plans to improve water quality conditions. The multiyear plan for the Drinking Water Quality Program (CALFED 2004b) recommends a Delta Improvements Package to address salinity problems in the San Joaquin River, improve agricultural drainage, and modify levees and water circulation in the Delta. The plan also calls for actions beyond the Delta to improve land management practices related to irrigated agriculture, managed wetlands, grazing, and urban runoff. The Ecosystem Restoration Program's multiyear plan (CALFED 2004a) recommends a variety of actions, including remediating mercury contamination, identifying and focusing on watersheds with the greatest toxic risk to wildlife, improving dissolved oxygen conditions in the Delta, and improving contamination-data systems. One approach that both improves water quality and provides wildlife habitat is the use of artificial wetlands as initial wastewater treatment filters.

Improving water quality in these Central Valley river systems is integrally linked to improving water quality in San Francisco Bay, which receives much of the contaminants. Other important actions for these river systems are described in the San Francisco Bay water quality section.

o. Regional water quality boards, in collaboration with other public agencies and private organizations, need to improve and maintain water quality in streams and tidal waters of San Francisco Bay.

The number and variety of contaminants entering the rivers and estuary is poorly known, as are their toxic effects, in part because the amounts and kinds are constantly changing. Reducing concentrations of contaminants is difficult, because it requires broad changes in land management practices and pest control practices in agricultural and residential areas.

Efforts to improve water quality need to account for residual contamination from past practices. Some resident wildlife species already contain high levels of contaminants in their tissues that are passed on to predators. Some contaminants, such as mercury, are difficult to remove because they are stored in river and bay sediments and gradually released over long periods into the water.

One of the main sources for water quality impairments in San Francisco Bay is drainage from the Central Valley. Thus, an integral part of addressing Bay water quality problems is the improvement of Central Valley water quality.

Other major sources of water pollution are from the lands around San Francisco Bay itself. To address this problem, state and federal agencies need to continue implementing the Comprehensive Conservation and Management Plan for the Bay and Delta (SFEP 1993). This plan includes actions such as watershed assessment, researching the effects of toxins on wildlife, reducing pesticide loads, supporting watershed management efforts, improving agricultural practices, reducing urban runoff, modifying wetlands flooding and drainage practices, and cleaning up environmental contaminants.

p. Fish and Game should expand funding and coordinate efforts to prevent the establishment of invasive species and to reduce the damage of established invasive species.

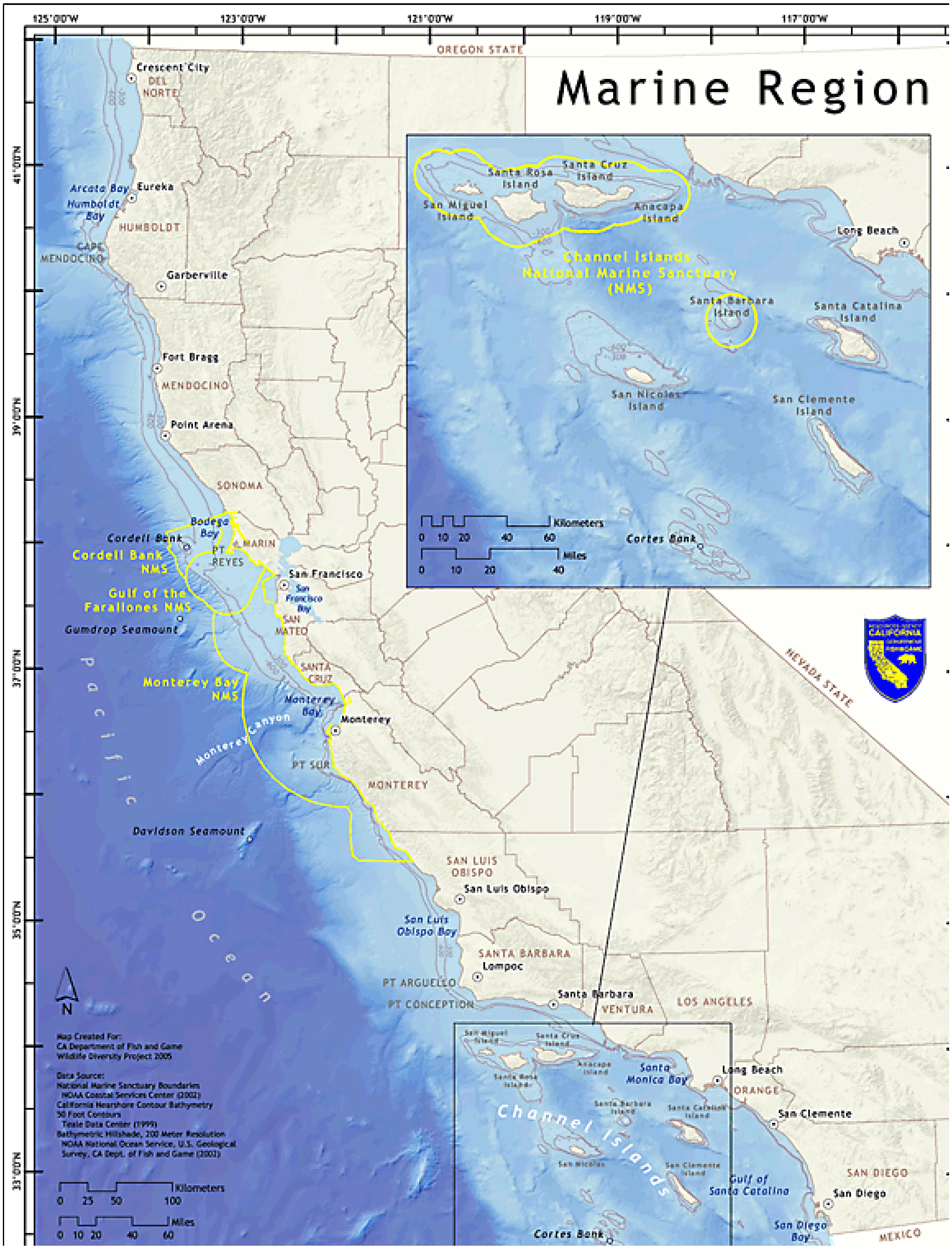
See Statewide Action f in Chapter 4.

An example program within this region that can be used as a model for implementing those recommendations is the San Francisco Estuary Invasive Spartina Project (2005).

The importance of river and estuarine systems makes aquatic invasive species of particular concern in this region. In addition to the statewide actions mentioned above, efforts are also needed to implement the California Bay-Delta Authority's Non-native Invasive Species Implementation Plan. This plan provides more specific actions related to collaborative partnerships, education, monitoring and assessment, research, technology transfer, and enforcement.

q. State and federal agencies should expand law enforcement funding and staffing and coordinate efforts to enforce regulations to prevent the degradation of rivers and streams and to detect, prevent, and take actions to protect water quality.

Adequate resource and water quality protection is an important element of river and estuarine system conservation. Agencies need to have sufficient staffing and funding to be proactive in identifying and detecting problems before they become significant environmental issues. Officers need the time and ability to monitor general compliance with environmental regulations, in addition to their duties in responding to specific service calls and related work. Such ongoing monitoring can prevent the degradation of these vital areas.


Marine Region
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123°00'W
121°00'W
119°00'W
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OREGON STATE
NEVADA STATE
MEXICO
Crescent City
DEL NORTE
Arcata Bay
Eureka
Humboldt Bay
HUMBOLDT
CAPE MENDOCINO
Garberville
Fort Bragg
MENDOCINO
Point Arena
SONOMA
Bodega Bay
Cordell Bank
Cordell Bank NMS
MARIN
PT REYES
San Francisco
San Francisco Bay
Gulf of the Farallones NMS
Gumdrop Seamount
SAN MATEO
SANTA CRUZ
Monterey Bay NMS
Monterey Bay
Monterey
Monterey Canyon
PT SUR
MONTEREY
Pacific Ocean
Davidson Seamount
SAN LUIS OBISPO
San Luis Obispo
San Luis Obispo Bay
SANTA BARBARA
Lompoc
PT ARGUELLO
PT CONCEPTION
Santa Barbara
VENTURA
LOS ANGELES
Santa Monica Bay
Long Beach
ORANGE
San Clemente
SAN DIEGO
San Diego
Gulf of Santa Catalina
San Diego Bay
Channel Islands
Cortes Bank
San Miguel Island
Santa Rosa Island
Santa Cruz Island
Anacapa Island
Santa Barbara Island
Santa Catalina Island
San Nicolas Island
San Clemente Island
Channel Islands National Marine Sanctuary (NMS)
Kilometers 0 10 20 40 60
Miles 0 10 20 40
N
Map Created For:
CA Department of Fish and Game
Wildlife Diversity Project 2005
Data Source:
National Marine Sanctuary Boundaries
NOAA Coastal Services Center (2002)
California Nearshore Contour Bathymetry
50 Foot Contours
Teale Data Center (1999)
Bathymetric Hillshade, 200 Meter Resolution
NOAA National Ocean Service, U.S. Geological Survey, CA Dept. of Fish and Game (2002)
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RESOURCES AGENCY CALIFORNIA FISH & GAME